PURDUE UNIVERSITY | College of Engineering

Engineering Faculty Document
No.: 47-24
December 4, 2023

TO: The Engineering Faculty

FROM: The Faculty of the Interdisciplinary Engineering Program

RE: Microelectronics and Semiconductors Major Curriculum Adjustment and course substitution request

The relevant Faculty of the Interdisciplinary Engineering, major in Microelectronics and Semiconductors, has approved the following curricular changes for the major. This action is now submitted to the Engineering Faculty with a recommendation for approval.

TITLE:

Interdisciplinary Engineering Master of Science, major in Microelectronics and Semiconductors

DESCRIPTION:

Purdue's Interdisciplinary Master of Science in Engineering, with a major in Microelectronics and Semiconductors, prepares professionals to become leaders in the microelectronics field and will help meet the growing demand for semiconductor engineers. Approved in 2021, the major requires some updates to adjust to rapid changes both in semiconductor technology and demand for skilled engineers.

RATIONALE:

Originally approved as an open-ended 30-credit interdisciplinary master's degree, the Microelectronics and Semiconductors major is ready for added structure to enhance learning outcomes, student success, and the overall student experience in the program.

Additionally, with the exciting option for students to concurrently obtain a Certificate in Global Supply Chain Management from the Daniels School of Business, we are requesting that MGMT 67000 be applied as degree credit as a substitution for STAT 51100 without special approval**.** Due to sequencing and availability, students are not always able to take STAT 51100. (see notes below)

Tamara Kinzer-Ursem
Associate Dean of Graduate and Professional Education,
Marta E. Gross Associate Professor of Biomedical Engineering

Academic and Administrative Contacts

Academic Lead: Vijay Raghunathan, School of Electrical and Computer Engineering
vr@purdue.edu

College of Engineering Administrative Support:

John Fassnacht
Principle Managing Director
Professional, Continuing, & Online Education
Purdue University Online
jfassnacht@purdue.edu

Alisyn Gruener
Senior Program Manager, Interdisciplinary Engineering
agruener@purdue.edu

MS Microelectronics and Semiconductors: Proposal to Adjust Degree Requirements

	Current	Proposed
Core Credits	n/a	18 – 9/ea from 2 topical groups
Electives	n/a	12 credits
Total Credits	**30**	**30**

Proposed Degree Requirements Detail

Total credit hours required: 30

Curriculum requirements:

- 9 credits each from two of the groups below (18 credits total)
- Additional 12 credits of coursework from this list

Core Requirements– select 9 credits from two of the following subject area groups

Group 1: Circuit Design (CD)

Course	Credits
ECE 55200 - Introduction to Lasers	3
ECE 55900 - MOS VLSI Design	3
ECE 59500 - Applied Quantum Computing I-Fundamentals	1
ECE 59500 - Applied Quantum Computing II-Hardware	1
ECE 59500 - Applied Quantum Computing III-Algorithm and Software	1
ECE 59500 - CMOS Analog IC Design	3
ECE 59500 - Data Analysis, Design of Experiments and Machine Learning	1
ECE 59500 - Fundamentals of Transistors	1
ECE 59500 - Introduction to Electronics Packaging and Heterogeneous Integration	3
ECE 60420 - Radio Frequency Integrated Circuits	3
ECE 60422 - Primer on RF Circuit Design	1
ECE 60423 - RF System Design	1

ECE 60424 - RF Design: Passive/Active Components	1
ECE 68800 - VLSI Testing and Verification	3
ECE 69500 - Advanced VLSI Design	1

Group 2: Devices and Manufacturing (DM) - add other MSE courses

Course	Credits
ECE 50631 - Fundamentals of Current Flow	1
ECE 50632 - Introduction to Quantum Transport	1
ECE 50633 - Boltzmann Law: Physics to Machine Learning	1
ECE 52600 - Fundamental of BioMEMS and Micro-Integrated Systems	3
ECE 55700 - Integrated Circuit/MEMS Fabrication Laboratory	3
ECE 59500 - Applied Quantum Computing I-Fundamentals	1
ECE 59500 - Applied Quantum Computing II-Hardware	1
ECE 59500 - Applied Quantum Computing III-Algorithm and Software	1
ECE 59500 - Data Analysis, Design of Experiments and Machine Learning	1
ECE 59500 - Introduction to Electronics Packaging and Heterogeneous Integration	3
ECE 59500 - Semiconductor Fundamentals	1
ECE 60600 - Solid State Devices I	3
ECE 69500 - Flexible and Stretchable Electronics	3
MSE 51000 – Microstructural Characterization Techniques	3
MSE 51800 – Failure Analysis	3
MSE 53000 – Materials Processing in Manufacturing	3
MSE 56800 – Additive Manufacturing of Materials	3
MSE 60000 – Materials Engineering Fundamentals	3

Group 3: System Design (SD)

Course	Credits
ECE 50631 - Fundamentals of Current Flow	1
ECE 51220 - Applied Algorithms	3
ECE 55900 - MOS VLSI Design	3
ECE 56500 - Computer Architecture	3
ECE 56800 - Embedded Systems	3
ECE 59500 - Data Analysis, Design of Experiments and Machine Learning	1
ECE 59500 - Introduction to Electronics Packaging and Heterogeneous Integration	3
ECE 68800 - VLSI Testing and Verification	3
ECE 69500 - Advanced Internet of Things Design and Applications	3
ECE 69500 - Advanced VLSI Design	1
ECE 69500 - Quantum Circuits and Systems	1
ECE 69500 - System-on-chip Design	3

Group 4: Supply Chain Management (SCM) *

Course	Credits
MGMT 66000, Operations Management	3
MGMT 66400, Supply Chain Management	2

MGMT 56500, Strategic Sourcing and Procurement (prerequisite = MGMT 66000 or 66400)	2
MGMT 56600, Global Supply Chain Management (prerequisite = MGMT 66000 or 66400)	2
MGMT 56000, Advanced Manufacturing Management (prereq = MGMT 66000)	2
MGMT 56800, Supply Chain Analytics (prereq = MGMT 66000; MGMT 67000 recommended	2
MGMT 56900, Ethical and Sustainable Supply Chain (prereq = MGMT 66000)	2
MGMT 59000, Frontiers in Manufacturing	1
MGMT 59000, Operations Management Essentials	1
MGMT 67000, Business Analytics / STAT 51100, Statistical Methods **	3

* Students completing this group may take an extra 3 credits in this group to obtain the Supply Chain Management Graduate Certificate. Students interested in this option should speak with their Academic Advisor.

** Engineering students will take STAT 51100 in place of MGMT 67000 unless STAT 51100 is not available (see request at the bottom of this page for an alternative). The Daniels School of Business has approved STAT 51100 as a direct replacement for MGMT 67000.

Elective Requirement: 12 credits of additional coursework from this list
Degree Total: 30 credits

Note re: Engineering Requirements:

A minimum of 18 credits of engineering courses (prefixes AAE, BME, CE, ECE, IE, ME, etc.) are required to complete an interdisciplinary engineering degree.

Interdisciplinary Engineering Advisors are responsible for working with students to develop an electronic plan of study that ensures a minimum of 18 credits of engineering coursework are mapped out for each advisee.

MS Microelectronics and Semiconductors: Proposal for Special Course Exception

Students enrolled in the Microelectronics and Semiconductors major who wish to pursue coursework in the supply chain area of study will be required to take STAT 51100, Statistical Methods, in lieu of MGMT 67000, Business Analytics. This allows students to obtain the appropriate prerequisite course for both engineering and business coursework.

In some cases—i.e. fall semester—STAT 51100 is not offered when students must take an analytics course for degree progression. In these cases, we propose to allow engineering students to take MGMT 67000 without special or additional approval. In 9 out of 10 cases, students will take the regular STAT 51100 course; this course exception approval on record will allow a seamless process for students unable to take STAT 51100 due to limited offering.

Curriculog entry will be created after the EFD is reviewed.

PURDUE UNIVERSITY
Krannert School of Management

MGMT 670 - Business Analytics
Dr. Andy Alexander

Instructor

Andy Alexander, Ph.D.
Online Office Hours: Every Wednesday, 1:00pm-2:00pm
Online Live Work Sessions: Most Thursday evenings from 6:00pm-7:00pm
Email: alexan11@purdue.edu

Course Description

Data analysis and modeling are important skills for effective managerial decision making in business and industry. Advances in technology have made gathering data and extracting valuable information far easier. These technologies, such as tablets and cellphones, web trackers, social media interactions, "smart" products, and many others, generate significant amounts of data and are available to managers. For example, the Dow Jones Industrial Average is one of the best-known and most widely watched indicators of the direction in which stock market values are heading. Administration and Congressional policymakers rely on statistics for budget decisions and related fiscal policy choices. The Federal Reserve System bases the monetary policy on data analysis. A manager needs to know whether the manufacturing process produces a quality product based on monitoring and assessing process performance. An effective sales manager must develop tools to regularly monitor the performance of the sales force, while an electronics manufacturer needs to produce a forecast of future sales in order to decide whether to expand production. Banks use customer data to identify and design lucrative banking products and find new viable services. These are a few of the many examples from business where statistics can improve company performance. The techniques learned in this course will help you infer data and make better informed decisions. The course covers basic probability, decision analysis, and statistical analysis (sampling distributions and hypothesis testing). Probability models provide tools to handle uncertainty and risk. Statistical analysis focuses on the presentation of data and techniques to draw useful and valid inferences from data. Decision analysis is a technique to use data to inform decision-making.

Course Outcomes

The course emphasizes applications of data analysis through cases and computer exercises. The focus of the course is as much on modeling and presenting solutions to business problems as on understanding statistical methods. Areas covered by the course include descriptive statistics, exploratory data analysis, probability, decision analysis, estimation, and hypothesis testing. By the end of the course, you should be able to:

- recognize and apply several commonly used statistical techniques in business;
- interpret practical business problems using statistical methods;
- defend your findings to an audience of managers and decision makers;
- design solutions using statistics software.

Technical Requirements

The following information has been provided to assist you in preparing to use technology successfully.

- Internet access/connection: high speed internet access recommended
- Headset/Microphone: recommended for synchronous sessions
- Microsoft Excel (available through the University)
- Minitab (accessible through Krannert RemoteApp)

VIRTUAL ACCESS TO SOFTWARE

The software above can be accessed over the web through ITAP's GoRemote system at https://goremote.itap.purdue.edu/ but a VPN connection is required off-campus. To start the process to set up a VPN connection to Purdue, click on this link - https://www.itap.purdue.edu/services/vpn.html. Almost all deliverables can be completed with Microsoft Excel or Minitab and both are available for free through the University.

Minitab Single-User 6-month rental: (optional)

If a student would prefer to use a locally installed version of Minitab, then the following link directs to the company's website and a short-term rental version is available for purchase.
Statistical Analysis Software for Students | Minitab

Learning Resources & Texts

Required Textbook:

Business Statistics: A Decision-Making Approach, 11th Edition, by Groebner, Shannon and Fry, Pearson Education

Physical ISBN-13: 9780137835324
Digital ISBN-13: 9780137835393

Note: Only the textbook is required for the course. Ignore the MyLab option.

Instructor's Online Hours

I will be available and respond to student questions within 48 hours during the M-F work week. Student inquiries made during the weekend may experience a delayed response time. Questions about the course content, assignments, or lectures should be asked in the *Questions and Answers* discussion forums in Brightspace. Students are encouraged to answer the questions their peers ask on the *Questions and Answers* discussion forums. Email should only be used for personal questions. When emailing me, please place the course number and section in the subject line of the email (i.e. MGMT 670-001, MGMT 670-DY1, or what appears in Brightspace). This will help tremendously in answering emails quicker.

Virtual Office Hours

Virtual Office Hours are a synchronous session (through Zoom) to discuss questions related to the course content. My virtual offices hours will be Tuesdays between 1:00pm-2:00pm Eastern and the Zoom link will be available in the Office Hours module in Brightspace.

Virtual Work Sessions

After the first week of class, I will offer one synchronous live session each week through Zoom. Students are encouraged to watch live and participate in the activity with their colleagues. For those students who are not able to attend, the sessions will be recorded and available later. As this is primarily an asynchronous course, these synchronous sessions are limited to no more than one hour per week.

Deliverables

You will have several individual and group assignments throughout the semester. Details on these assignments, along with rubrics to guide evaluation will be posted on Brightspace. The due dates for the assignments posted on the course website are in Eastern Time (the local time zone of West Lafayette, Indiana).

Deliverables	Points
Online Discussion in Yellowdig (runs the entire length of the course)	15%
Exercise Problem 1	5%
Exercise Problem 2	5%
Exercise Problem 3	5%
Exercise Problem 4	5%
Quizzes (4 in total)	12%
Case 1 (Team assignment)	6%
Case 2 (Team assignment)	6%
Case 3 (Team assignment)	6%
Midterm Exam	15%
Final	20%
Total	100

Yellowdig

Instead of the traditional weekly discussion forum approach to student engagement in an online environment, we will use Yellowdig (https://yellowdig.com), a course long, customizable, student-driven social platform that encourages participation. See more information about Yellowdig and how we will use it throughout the course in Activities for Unit 1 in Brightspace.

Krannert Grading Policy

The target grade distribution for all *core courses* is 35-40% A/A-, 50-55% B+/B's, 5-10% B-'s, 0-5% C+ or below resulting in approximately an average Grade Point Average (GPA) of 3.35 for each core course where the GPA is calculated as A = 4, A- = 3.70, B+ = 3.30, B = 3.00, B- = 2.70, C+ = 2.30, C = 2.00, C- = 1.70, D = 1.00 and F = 0.00.

Participation and Assignment Policies

Your Role in the Course

Each student is expected to be prepared each week, to contribute in Yellowdig (our online discussion platform), and to complete all assigned readings and exercises. Lecture material will be posted on the course website. Students are expected to be aware of the announcements, events, and files posted on the course website. The class will be divided into several teams and cases assignments will be handed in as a team. Teamwork is subject to the following rules:

- If a team member does not contribute, then his/her name should not appear on the assignment handed in. He/she may do the entire assignment and submit it separately.
- Active participation within teams is encouraged and is viewed as essential for clarifying difficult concepts. Thus, each team member will evaluate his or her team members at the end of the course.

Proficiency in working with data and statistical modeling can be attained only through extensive practice with textbook problems and cases. It is recommended that students review the numerous exercises in the textbook on their own and practice as they will feel necessary. Homework exercises and case assignments must be turned in on the specified due dates and times through Brightspace. For individual assignments, include your name and

assignment number in the name of the uploaded file, and for cases include the team number/name and case number.

Format of Case Report

The write-up should not exceed six one-sided letter-size pages, including visual material such as charts, graphs, and tables. The reports must be typed using font sizes of at least 11 points, and margins of at least one inch on each side. Readability is of paramount importance. Adherence to type size and margin requirements is important to ensure fairness across teams. A typical report contains the following sections: (1) introduction and problem statement, (2) summary of results, (3) analysis, both technical and non-technical, (4) recommendations, and action plans/suggestions for future study, and (5) all attachments (graphs, tables, etc.). Even though some of the analysis is technical and is presented as such, the results must be summarized and interpreted so that they are accessible to a non-technical audience. More specific expectations of the case report may be provided with each case. In case of conflict with the above, the guidelines included with your case should be followed.

Exams: The midterm and final exam multiple choice exams will be available for a few days to allow students flexibility. Further details (such as time length, notes policy, etc.) will be specified closer to the exam dates.

Netiquette

Students are encouraged to comment, question, or critique ideas in Brightspace and Yellowdig. However, be mindful that sarcasm and humor can be easily misconstrued in online interactions. Please read the Netiquette rules for this course:

- Give other students the opportunity to join in the discussion.
- Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language. This could possibly lead to misinterpretation.
- Keep an “open-mind” and be willing to express even your minority opinion.
- Think and edit before you share (e.g., post or email).
- Ask for feedback.

Academic Dishonesty

Course Honor Policy

We expect and encourage students to discuss readings, case materials, and the concepts covered by the course with one another. However, do not falsely represent someone else’s work as if it were your own. Students are expected to prepare case, homework, or other assignments without the assistance or reference to students in another section, who have taken the class before, prior semester’s class notes and the like. A team is not allowed to cooperate with other teams. In cases of academic dishonesty, the instructor reserves the right to award zero points on the deliverable for the individual/team, award a failing grade for the course, and refer the matter to the university for further action. The use of the internet for finding solutions to cases and problems is prohibited. Students are expected to follow Purdue regulations governing student conduct (see http://www.purdue.edu/univregs/studentconduct/index.html). While working in teams, each team member is expected to understand the reason for choosing a particular technique, the mechanics of the solution procedure, and the implications of the final solutions and recommendations.

Course Integrity

Students are encouraged to discuss readings, computer exercises, homework exercises, and other course content with classmates. Such discussions constitute a valuable aspect of the student's own learning experience. However, cheating on homework, quizzes, or exams will result in a score of 0 on that assessment and further punishments are at the instructor's discretion. Cheating on the final will result in an automatic grade of F for the course. Students are strongly recommended to read the academic integrity guide published by the Office of the Dean of Students at:

http://www.purdue.edu/odos/osrr/academic-integrity/index.html

Purdue University Honor Code

The purpose of the Purdue University academic community is to search for truth and to endeavor to communicate with each other. Self-discipline and a sense of social obligation within each individual are necessary for the fulfillment of these goals. It is the responsibility of all Purdue students to live by this code, not out of fear of the consequences of its violation, but out of personal self-respect. As human beings we are obliged to conduct ourselves with high integrity. As members of the civil community we have to conduct ourselves as responsible citizens in accordance with the rules and regulations governing all residents of the state of Indiana and of the local community. As members of the Purdue University community, we have the responsibility to observe all University regulations.

"As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue."

To foster a climate of trust and high standards of academic achievement, Purdue University is committed to cultivating academic integrity and expects students to exhibit the highest standards of honor in their scholastic endeavors. Academic integrity is essential to the success of Purdue University's mission. As members of the academic community, our foremost interest is toward achieving noble educational goals and our foremost responsibility is to ensure that academic honesty prevails.

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials and the instructor to potential breeches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

Purdue prohibits dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty. Furthermore, the University Senate has stipulated that the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest.

Please review the following resource page on plagiarism:
https://www.purdue.edu/provost/researchIntegrity/plagiarism.html

Emergency Statement

In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. All changes will be communicated through Brightspace.

Disability Statement

Students with disabilities must be registered with Disability Resource Center in the Office of the Dean of Students (ODOS) before classroom accommodations can be provided. If you are eligible for academic accommodations because you have a documented disability that will impact your work in this class, please schedule an appointment with me as soon as possible to discuss your needs.

Course Schedule

Unit	Topics	Readings	Assignments
Module 1 – Descriptive Statistics and Basic Probability	Week 1 • Descriptive Stats, Types of Data • Graphs, Plots, Covariance, Correlation	• Chapter 1 • Chapter 2 (optional) • Chapter 3	1. Investigate the Yellowdig platform 2. Complete Readings (not graded)
	Week 2 • Experiments, Outcomes, Basic Probability • Decision Making under Uncertainty	• Chapter 4	1. Exercise Problem 1 2. Quiz 1
	Week 3 • Discrete Distributions • Continuous Distributions	• Chapter 5 • Chapter 6	1. Case 1 2. Exercise Problem 2 3. Quiz 2
Module 2 – Inferential Statistics	Week 4 • Sampling Distribution and Estimation • Estimates, Confidence Intervals, t-distribution, sample size	• Chapter 7 • Chapter 8	1. Midterm Exam
	Week 5 • Hypothesis Testing, z-tests • P-value	• Chapter 9	1. Case 2 2. Exercise Problems 3 3. Quiz 3
	Week 6 • 2 Sample Tests • Pooled variance	• Chapter 10	1. Case 3 2. Exercise Problem 4 3. Quiz 4
Module 3 – Modeling	Week 7 • Simple Linear Regression, Least Squares Estimates • Error Variance, Coefficient of Determination	• Chapter 14	1. Final Exam